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RED SNOW.

BY F. C. CLARK, M.D.



PERHAPS no more curious phenomenon meets the gaze of the Arctic observer than what is familiarly known as “red snow;” and truly a beautiful sight must the little plant present, in direct contrast with the expanse of white, whether appearing in thinly scattered patches, or crimsoning the hills and plains for miles around.

The subject has ever been of the deepest interest, and excited the attention of the most eminent scientists. For a long time its true place in nature remained undetermined. On each side of the contest as to its affinities were arrayed most distinguished authorities, each claiming to have solved the mystery. Yet it was only after many conflicting opinions that its true position was determined. Hence if the vegetable origin of “red snow” seems conclusive enough to us, we must not forget the advantages we possess over former observers. The microscope, the natural sciences and mechanics, have all received marked improvement since the first discovery of the snow plant.

The history of the *Protococcus nivalis*, as named by Agardh, dates from a very early period in antiquity. Aristotle tells us it was known in his time. In fact it was one of the chief objects which attracted the attention of mountain travellers and of adventurers in the frozen regions of the North.

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But the most accurate accounts extant only date from 1760 of the present era. Saussure about this time made careful examinations of "red snow" obtained from the Apennines. The result of his investigations was the discovery of a vegetable substance which he supposed was the pollen of some plant.

The subject now remained quiescent until the return of the Arctic exploring expedition under Sir John Ross in 1819. New material was now obtained for examination. Specimens of "red snow" were sent to Robert Brown and Francis Bauer.

Brown gave it as his opinion that the snow plant was a unicellular plant belonging to the order of Algæ.

Bauer, however, dissented from Brown, and declared it to be a species of fungus (*Uredo nivalis*). Apart from his conclusions upon the subject, he made many interesting experiments with the plant. Its microscopical appearances and also analysis were given. But perhaps the most curious experiment was his attempts at propagating the Protococcus.

For this purpose he placed some of the "red snow" given him by Sir John Ross, and which had already become white from long exposure to the air, in a glass vessel filled with snow, taking care to mix the two well together; on exposing the vessel of snow in the open air for some time, and, fortunately, while the weather was unusually cold (in December), he found the snow to change from white to pink; and finally to regain its original color, and its quantity also to increase.

Not satisfied with this, he carried his investigations still further. He put a small quantity of the snow plant upon the surface of some snow, and watched the result. The temperature being sufficiently low, the same changes were observed as occurred in the former instance, but a greater increase in bulk of the plant.

From these experiments Bauer concluded that the young plant became green before it matured; that a certain degree of cold was necessary for its production, and that, if exposed to the open air alone for some days, the plant would lose its red color.<sup>1</sup>

In 1823 Baron Wrangel after careful analysis denied the conclusions arrived at by former observers, and pronounced the plant to belong to the lichens, naming it *Leprasia Kermesina*. So in-

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<sup>1</sup> Philosophical Transactions, 1820, Part 1, pp. 165-174.

"Microscopical observations on Red Snow, by F. Bauer. Journal of Sci. and Arts (Royal Inst. of Gr. Br.), vol. vii, 1819."

stead of clearing away all doubts he only served to introduce new matter for discussion.<sup>2</sup>

Two years afterwards the question was again agitated by Agardh and Dr. Greville<sup>3</sup> of Edinburgh. Both these observers agreed in every particular with Robert Brown. Sir William Hooker also, the eminent naturalist and botanist, later confirmed the views of Agardh and Greville; but he named the "red snow" *Palmella* instead of *Protococcus nivalis* Agardh. The algal nature of the plant was thus decided for a time.

During the year 1838 several observers on the continent, among whom may be mentioned Kunze, Unger and Martius, wrote elaborate monographs upon the subject, but without eliciting anything new.

Thus far we have had to do only with believers in the vegetable origin of the *Protococcus*. There are almost as many eminent observers arrayed on the opposite side, who pronounce in regard to its animal nature.

In August, 1839, Mr. Shuttleworth,<sup>4</sup> an English resident of Switzerland, understanding that "red snow" had been discovered in the vicinity, betook himself thither, and by the aid of his microscope was enabled to make out the presence of animalcules. Adding to these examinations he described two species of low animal organisms, and proclaimed the animal nature of the snow plant.

In 1840, Professor Agassiz of Neufchatel made a tour to the glacier of Aar, and discovering "red snow" there, carefully examined it with a microscope, and presented his views concerning the plant before the British Association at Glasgow. Not only did he fully confirm the conclusions of Shuttleworth, but he added four other species of animalcules to those already discovered and described by Shuttleworth. Agassiz considered that the opinions of former observers were due to their mistaking the *ova* of animalcules for the spores of a plant.<sup>5</sup>

After the confusion necessarily arising from such a variety of

<sup>2</sup> Penny Encyclopedia.

<sup>3</sup> "Scottish Cryptogamic Flora," by Robert K. Greville. Edinb., 1825-1829. Vol. iv, p. 231.

<sup>4</sup> "Nouvelles observations sur la matière colorante de la neige rouge," par James Shuttleworth. Bibl. Univ. xxv, 1840. Edinb., New Phil. Journ., xxix, 1840. Forriep. Notizen, xvi, 1840. Also Bibl. Univ. xxv, 1840. Edinb. New Phil. Journ. xxix, 1840.

<sup>5</sup> *Loc. cit.*

opinions, and each advocated by unimpeachable authorities, had somewhat subsided, the true nature of the *Protococcus* was at length decided. And to-day its vegetable origin is no longer doubted. It holds no middle place between the animal and the vegetable, as some have thought, nor is it even a low animal organism; but in every sense of the word an alga, as Brown, Agardh, Greville, Hooker, and many other eminent authorities have since declared.<sup>6</sup>

Animal substances, it is true, are found present in the alga. But this is easily accounted for when we consider the immense numbers of low animal, as well as vegetable organisms, floating in the atmosphere, and even in the most frigid of climates.<sup>7</sup>

Mineral substances are also present, thus misleading the chemist as well as botanist and naturalist. Hence analyses of the snow plant often strengthen the observer's private opinions, thus rendering a bias of judgment almost unavoidable.

Botanists refer the snow plant to the family *Palmellaceæ*, the lowest of plants, and related to the *Confervaceæ*. It is propagated like all the members of this family, by a kind of gemmation. A tube-like process shoots out from the plant dilating at the extremity. Gradually a cell is formed at the end of the tube, which continues contracting until the new cells lose all connection with the mother-plant, and become distinct individuals.

In some species of this family true segmentation is the rule. In this mode of reproduction the young plants exhibit for a short time remarkable powers of locomotion, which are due to the rapid vibration of an immense number of cilia. When this motion ceases, then is the signal for segmentation or reproduction to begin. When segmentation ceases, motion reëstablishes itself, then segmentation recommences, and so on.<sup>8</sup>

The vibration of these cilia has undoubtedly led observers, opposed to the vegetable origin of *Protococcus*, to regard it as similar to the zoospores of certain Protozoa. For it is a well-known fact that "red snow" possesses some degree of motion.

The *Protococcus* is very minute, in fact microscopical. Under the microscope it has the appearance of brilliant garnet-colored

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<sup>6</sup> Brand's Dict., of Sci. Lit. and Art.

<sup>7</sup> Kane's Narrative, 1854. pp. 138-140.

<sup>8</sup> Chamber's Encyc. *vid.* *Palmellaceæ*. (See also Clark's "Mind in Nature," for original observations on American specimens by this eminent observer, illustrated by figures.—EDS.)

disks resting upon a matrix of gelatinous matter. They resemble to a remarkable degree the red globules of the blood in size and color. But Bauer gave their size as  $\frac{1}{1200}$  inch in diameter; whereas more careful measurement will show the diameter of the disks to be nearer  $\frac{1}{3500}$  or  $\frac{1}{4000}$  inches. Each one of these globules is made up of seven or eight cells filled with a liquid, which probably contains the coloring matter of the *Protococcus*. But Brocklesby thinks the liquid contains great numbers of animalcules.<sup>9</sup>

Bauer, Wollaston, DeCandolle, Hooker, Peschier and others give chemical analyses of the snow. But as they all give nearly like results, the analysis of Peschier is only subjoined, viz. :

Silicious matter . . . . .	66.50
Alumina . . . . .	6.35
Peroxide of iron . . . . .	21.35
Lime . . . . .	1.17
Organic matter . . . . .	6.80 <sup>10</sup>

The "starch test" proves the vegetable origin of *Protococcus* perhaps better than any other.

The genus to which the snow plant belongs takes a variety of forms; of dust-like particles, as in the case of "red snow;" of a stringy gelatinous mass as in "gory dew;" or of a thin and membranous structure, like a frond.

Dr. Kane found the color to be of a dark red. On paper it produced a cherry red stain, which became brown on exposure to the air. Its solution in water, in which red snow is very soluble, is of a muddy claret color. But if the snow were damp, upon which it was found, the snow beneath was stained a beautiful pink.<sup>11</sup>

The *Protococcus* is found above 83° north latitude, and as far south as in New Shetland in 70° S. Lat. Sir John Ross saw it extend over the cliffs bordering upon Baffin's Bay for a distance of eight miles, and, in some instances, to a depth of twelve feet. To this day the heights are called the "Crimson Cliffs."<sup>12</sup>

Parry found "red snow" even far from land upon the ice-fields of Spitzbergen. Kane obtained it fifty miles from land upon the flocs of ice. Here it seems to have been diffused through the

<sup>9</sup> Brocklesby's *Meteorology*, pp. 120-121.

<sup>10</sup> Penny *Encyclopaedia*.

<sup>11</sup> Kane's *Narrative*, 1851, 1854. pp. 133-140.

<sup>12</sup> Kane's *Narrative*.

atmosphere over the Arctic snows like other organic matter. Kane also found it mixed with foreign vegetable matters, which might perhaps be the source of the ammonia necessary for its existence. Indeed the snow plant was always of a deeper red, and in a more flourishing condition in proportion to the quantity of this extraneous matter.<sup>13</sup>

This alga is found also upon the tops of high mountains above the snow-line. It has long been known to exist in the Apennines and Pyrenées Mountains. The recent discovery of the snow plant in our own country (in California) upon the tops of the Sierra Nevadas, at an altitude of 10,000 feet above the level of the sea,<sup>14</sup> renders the subject under discussion of twofold interest. Specimens obtained from this locality show the same structure and microscopical appearances as those from other parts of the world.

Damp places, near the ocean or fresh water, seem to favor its production. The specimens supplied to Dr. Greville were from the shores of Lismore, off Scotland. It was found upon reeds and stones, but grew to perfection upon calcareous rocks.<sup>15</sup>

A species of alga (*Uredo viridis*) of a greenish color has been described. But Martius refers it to the *Protococcus nivalis*, though in a different stage of development.

Other varieties of colored snow have been mentioned, which are confounded with *Protococcus*. What is known as "brown snow" is due to a discoloration of the snow by earthy matters washed down by mountain streams. Arctic observers (Belcher) speak of a red snow produced by a species of little auk which feeds on shrimp and congregate there in immense numbers.

Snow and ice often appear colored from reflection. These illusory appearances are easily explained. Dr. Kane speaks of "red ice" which, on a nearer inspection, proved to owe its red color to reflection. The same observer mentions "blue ice" as being sometimes seen, and due to like causes.<sup>16</sup>

But apart from all this, the *Protococcus* declares its vegetable

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<sup>13</sup> Kane's Narrative.

<sup>14</sup> It was also discovered at an elevation of 6,500 feet on the Cascade Range in Washington Territory by the late George Gibbs. See *NATURALIST*, v, p. 116, 1871. — Eds.

Red snow is not seldom found among the Sierras, in the so-called Alpine regions; in Clover Mountains, East Humboldt, Nevada and the Uintahs, from July to September. It is found upon old snow drifts (vid. U. S. Geol. Explor. of 40th parallel, vol. v, Botany, 1871. Page 415, Prof. H. C. Woods).

<sup>15</sup> Penny Encyclopedia.

<sup>16</sup> Kane's Narrative, pp. 138-140.

origin. And yet, why it should prefer to make the snow its habitat, or how it can find its way into those regions of frost and infertility, remains a question which still perplexes the naturalist and philosopher.

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## THE SISCO OF LAKE TIPPECANOE.

BY PROF. D. S. JORDAN.

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A SHORT time since, I received from Prof. E. T. Cox, state geologist of Indiana, a collection of deep-water "Siscoes" taken in Lake Tippecanoe, Kosciusko Co., Indiana, by Judge J. H. Carpenter of Warsaw. Prof. Cox requested me to examine these fishes, and prepare an account of their characters and relationship, as considerable interest is attached to them as well as to the fauna in general of the "bottomless lakes" of northern Indiana.

I find them to be Salmonoids belonging to the genus *Argyrosomus* of Agassiz, a group closely allied to the white fishes (*Coregonus*) but distinguished by the greater development of the lower jaw, which usually projects decidedly beyond the upper, the reverse being true of *Coregonus*. The maxillary bones are rather longer, and the bones of the mandible rather heavier, and the teeth although very feeble are slightly stronger than in *Coregonus*. Compared with *Coregonus* most of the species have a more slender form; hence their popular name of "lake herrings," although their resemblance to the sea herring is quite superficial.

This Indiana *Argyrosomus* appears to be quite distinct from the species found in Lake Michigan; *i. e.*, the shallow-water "herring" (*A. clupeiformis* Mitch.) and the deep-water "moon eye" (*A. Hoyi* Gill) and "black fin" (*A. nigripennis* Gill), and it is presumably different from *A. harengus* (Rich.) and *A. lucidus* (Rich.), which, if really distinct species, seem to be loose-scaled, shallow-water fishes, allied to *A. clupeiformis*.

It seems to be identical with the "Sisco" of the deep lakes of southern Wisconsin, a fish, which, although known for some time to naturalists, has not yet, as far as I am able to ascertain, received any specific name.

I have therefore ventured to describe these fishes as new, under